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ABSTRACT

Recent theories associated with physical reality have increasingly been adapted as social-science paradigms. Chaos Theory and Perceptual Control Theory (PCT) are two advances that are applicable to the educational administration field. According to Edward Lorenz's Chaos Theory, profound changes in outcome can arise from small variations of input. Perceptual Control Theory, deriving from Harold Black's 1927 engineering experiments with closed-loop control systems, was applied to social systems by William T. Powers in 1973. According to Powers, individual control systems facilitate behavior by controlling perceptions. Gregory Bateman's Double Description concept is coterminous to viewing multiple realities, since, as PCT ascribes, we are unable to enter another human being's version of reality. By using PCT and Double Description together, an administrator can gain multiple insights into the socio-historic, temporal, or environmental aspects of school policy or teaching. Chaos Theory, PCT, Double Description, and the sense-and-respond paradigm allow administrators to fulfill their critical administrative responsibilities: goal attainment, cultural maintenance, internal integration, and external adaptation. Through this integration procedure, administrators can operate as adaptive, enlightened professionals capable of interpreting external changes while remaining true to their organization. (Contains 12 references.) (MLH)

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# Administrators in Wonderland: Leadership through the New Sciences

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## INTRODUCTION

Recent theories associated with physical reality have increasingly been adapted as social science paradigms. Pedagogy and educational administration have also been affected by this social science paradigm shift. These emerging theoretical paradigms have forced educational administrators to consider new methodologies for implementation into school evaluation and improvement. Chaos Theory and Perceptual Control Theory (PCT) are two such advances which, in my opinion, are applicable to the field of educational administration. Chaos theory has appeared substantially in educational literature in the last five years. Currently PCT, on the other hand, remains unpublished in the area of education. Educational administrators have always operated under diverse conditions dictated by complex realities which exist in schools affected by a plethora of constantly changing variables. The new sciences, like chaos theory, allow for an administrator to acknowledge the continually changing environment of a school and adapt to these variations in order to maximize a school's productiveness. With the acknowledgment of critical phenomenon associated with chaos theory, administrators can lead their schools into a prolific and productive twenty first century.

## CHAOS THEORY

When Edward Lorenz serendipitously discovered chaos theory in 1961, conceptual comprehension of the world around us was forever altered. No longer would human understanding be restricted to mere linear and mechanistic paradigms derived form Cartesian dualism, Newtonian physics and the scientific revolution. When Lorenz, the meteorologist, was experimenting with modeling and weather prognostication, he simply altered input data slightly. He then witnessed profound output changes resulting from these infinitesimal variations in input values. Chaos theory was born. Lorenz referred to these variations in output, from minuscule changes in input, as the

butterfly effect. To understand the importance of this concept , envision a butterfly floating over a particular country in East Asia. When this butterfly flutters it's wings, a small current of air is formed which inevitably alters the weather pattern. These changes, over a period of time, result in a hurricane off the coast of California. This is the butterfly effect; profound changes in the outcome generated by small variations of input.

Chaos, for the majority of human beings, refers to a situation where anarchy reigns supreme and no hope of control can possibly exist. Yet chaos theory doesn't adhere to such a paradigm of reality. In chaos theory, a phenomenon exists which demonstrates a formation of patterns in chaos systems. This phenomenon is referred to as strange attraction. When output of these non-linear functions are graphed, points seem to wobble around central areas. Strange attraction is analogous to the concept of a center of gravity (LeCompte, 1994). These areas, which attract data, are referred to as a strange attractor due to their seemingly odd propensity to entice values of the function around certain areas. This clustering effect is quite fascinating and illustrates the true nature of chaos theory; patterns exist in the perceived world of chaotic systems.

**CHAOTIC APPLICATIONS TO EDUCATIONAL ADMINISTRATION**

Administrators must constantly engage in public discourse and justify expenditures, test scores, behaviors, etc. Without continual evaluation these external sources of concern can develop into problematic situations which are difficult or nearly impossible to resolve. In recent years, site based management attempts have resulted in an improved psychological working conditions for teachers. Yet external gate keepers remain dissatisfied with academic and standardized test results. Stephen Haeckel, A business consultant, provides a model which allows for organization to adapt more easily to external changes. Rather than adhering to bureaucratic policy which is instituted in a top - down fashion, organizations should operate out of a sense and respond paradigm. "

[Administrators] don't spell out how people do things. Rather, they set limits on how these things can be done," states Haeckel (Haeckel, 1995:10). This model allows for objectives to act and operate as guides similar to the concept of strange attractors. Policy guidelines regulate outcomes but not function limitations. Limits provide the teachers and other staff to remain empowered yet build accountability into the policy. Decentralization efforts must continue to institute accountability hierarchies in order to yield productive results (Haeckel, 1995). Although this model seems similar to a neo-scientific approach, where test scores operate as the manager monitoring progress and job quality, in reality the criteria for evaluating outcome completion is not based entirely on test score results. Attitude adjustments, improvement in skills and knowledge acquisition, etc. can also operate as accountability structures to balance performance based assessment and other standardized test evaluation of teacher effectiveness.

Remaining sensitive to input variations assures an organization will adapt and respond to external changes (LeCompte, 1994). Consider the Rodney King court case in Los Angeles. A verdict decision, a microscopic input on the scale of society, resulted in the tragedy of the Los Angeles riots. Small decisions or interactions, if not observed under proper context, can yield actions which result in irreparable damage. Dissatisfaction, which had accumulated over hundreds of years, was vented through this particular output. Chaos theory allows an administrator to practice prevention and adaptation. Past socio-historic knowledge has demonstrated the fact that in order for organizations to survive they must adapt to external conditions or risk extinction. Yet systems in order to adapt to external conditions must be flexible. Institutions of learning, which were designed in the past, lack flexibility (Garmston & Wellman, 1995). If we don't sense environmental changes we risk witnessing organizational failure or at worst extinction. Schools which are resistant to change are increasingly at risk for failure (LeCompte, 1994). We must move for school reform

which integrates a model of external adaptation.

The Los Angeles riots, mentioned above, are a prime example of how a seemingly stable environment can erupt into a societal perceived notion of chaos. Primary to the concept of chaos is turbulence. Events over time result in random shocks which force the system out of equilibrium (Griffiths et al, 1991). A resilient organization is able to balance itself quickly. Yet as these random shocks accumulate and a system resists adaptation and evolution the organization places itself in jeopardy of extreme trauma or ,in the worse case scenario, collapse.

Therefore, in order to maintain an adequate level of stability, organizations must utilize a sense and adapt methodology. By sensing external and internal environmental variations, an organization can implement change which leads to productive survival.

Through understanding the chaos model of reality, we can utilize a sense and respond model to improve adaptation in educational organizations. To initiate this process an administrator must ask her/himself two questions: (1) what's occurring on the outside of our environment (consider external adaptation) and; (2) how do we operate within our organization (internal integration)? (Haeckel, 1996). Through focusing on the answers to these two questions there is a continually acknowledgment of the school's focus, mission and vision. Haeckel suggests a continual check and balance cycle: sense, act, interpret, decide. Through this circuit, an observation of external influences is imminent at all times. Once objectives are determined, an adaptation loop can be designed to meet these goals. An adaptation loop is a cycle of sensing external changes and determining an action in accordance with these changes. With designing an adaptation loop it is best to work backward from the desired outcome objective. Through a series of asking questions and arriving at solutions, your adaptation loop is created from outcome to initial actions which must be facilitated in order to assist in your school's desired outcomes becoming reality(Haeckel, 1996).

For example, if your intended outcome is to maximize student learning you ask the question, "how can I maximize student learning?" "Learning is maximized when students are active learners in the classroom." The answer to this initial question becomes the next objective. Now how do we arrive at this objective? "Learners are active when course work is presented through a variety of mediums." Again you ask yourself how to achieve this objective and so on in the process. This process leads you to initial actions which can facilitate the entire process. Yet caution should be applied to this process. This process is meant to be implemented in the adaptation loop. Through a continual sensing of the external environment, methods to achieve desired outcomes will continually evolve with the utilization of such a loop.

**PERCEPTUAL CONTROL THEORY**

Perceptual Control Theory arose out of engineering experiments completed by Harold Black, in 1927. Black facilitated and completed research on closed loop control systems (Forssel and Cziko, 1996). These pioneering works led to the introduction of Perceptual Control Theory, as applied to social systems, by William T. Powers in 1973. Powers utilizes the notion that behavioral control operates as a process within each individual. Consequently, individuals behave according to their perceptions (McClelland, 1996). Individual control systems facilitate behavior by controlling perceptions (Powers, 1973 in Marken, 1990). Contorl in this context is meant to denote purposeful behavior. Each individual is comprised of lower-level and higher-level control loops which dictate behavior. Higher-order loops regulate value and belief systems. Lower-level loops, on the other hand, regulate physical movements by the body. As an individual experiences an event, they view this situation through their system of higher-order control loops. Reference signals, in the control loops, act as value regulators. As information is received by the individual, comparisons between perceived data and belief are facilitated. According to this, reference signals will dictate a course

of action. Therefore, perception is indeed reality.

Control systems, which operate inside each individual, are comprised of three components and three signals (Marken, 1990). Components include a sensor, compatitor and an output amplifier. Signals consist of perception, reference and error. Through an interaction, these components and signals comprise the concept of control theory. As information is received by an individual, the sensor transforms this information into a reference signal. Determining the difference between the reference signal and the perceptual signal, the compatitor converts this discrepancy into an error signal. Output amplification utilizes this error signal and returns a refernce variable. "Controls, then, are hierarchically structured information processing operations which result in corrective action undertaken for the purpose of reducing the perceived disparity between acutal and desired performance" (Dobuzinskis, 1992: 357). A real world example will help to comprehend the process. Take for instance a wife who has arrived home from work early to prepare for her husband's arrival; it is there anniversary. As the husband arrives, he expresses nothing but discontent about his work and poor day. As the husband continues, the wife's internal perception senses that John has forgotten about the anniversary. Her expectations are different than the reality which currentyl exists. Consequently, her internal control system returns an error signal which then altered into an emotional response of sadness and frustration. "An emotion is a perception of a body state which starts from an error signal," (Goldstein, 1989 in Goldstein, 1990). The importance of control theory is the notion that perception is reality. We act each day through perceived intent yet we can't be assured of outcome until we receive feedback from another individual or an effect of our action. Yet consider the times of your life were the feedback was negative although you and other witnesses agree that there was indeed a positive intent of your actions. The other party involved in this social discourse perceived your action through their control system. Internal feedback produced an error

signal which facilitated their action and emotion of discontent. Although this information at this particular stage is quite theoretical and postulates a model of purposeful behavior, we can utilize this theory to move toward a practical approach to leadership and administration. In fact, Marken has derived a test to determine an individual's reference signals in order to begin to reorganize control loops in order to arrive at desirable organizational outcomes. We will discuss this test momentarily but first we must examine how behavior is altered through the paradigm of control theory.

In order to affect anther individual's action, we must create a disturbance with adequate strength to change the reference signal of their control loops. As McClelland demonstrates, the reference signals must be altered in order to facilitate behavioral change:

> As discrepancies arise between the reference value one has adopted for [a group's] action.... one adjusts one's behavior to maintain the hypothesis about the other's intentions, or else, if the discrepancy continues and increases, one is forced to re-categorize the other's behavior by forming a new hypothesis about the others intention, which then becomes the new reference value to be maintained if possible in the ensuing interaction. (McClelland, 1996:)

PCT operates under the obvious assumption that individuals are unable to manually go inside someone's brain to operate control systems located inside (Powers, 1973 in McClelland, 1996). Furthermore, to alter behavior we must attempt to align reference signals to guarantee purposeful behavior which matches our desires outcomes. Through coercion or other methods of force, individuals may change their actions yet adherence is not guaranteed. When people decide to conform to what has been asked of them they maintain control of their perceptions (McClelland,

1996). Furthermore, the "victim of force, frustrated in one initiative, selects from his repertoire of reference signals a different line of action to meet his own higher-level goals, not the goals of the person using force." (McClelland 1996:25). In order to assure behavior, which is cohesive with the mission of the organization, we must align reference signals of the all individuals with that of the organizational philosophy.

" PCT requires a major shift in thinking from traditional approaches: that what is controlled is not behavior, but perception," states Powers (Forssel & Cziko, 1996:1). Under this paradigm shift, internalized perception is what yields behavioral outputs. Under PCT, control is defined as purposeful behavior (Forssel & Cziko, 1996). Methods of coercion or incentive are not affective if individuals targeted choose to avoid this message (McClelland, 1996) therefore alternative influences must be considered. Niklas Luhmann adds that, "The glue of social systems is meaning and one only selects actions, or communications, that are meaningful" (Luhman in Beavis, 1996:14). PCT yields control, purposeful behavior, when a group of individuals aligns there reference signals (McClelland, 1996). Therefore control arises out of social group alignment. As discussed above, the power of an organization is inherent in it's ability to align reference signals. McClelland illustrates this point:

> For practical purposes, alignment is social power. The social structures we think of as powerful--armies, government bureaucracies, capitalist enterprises-- derive their power from the willingness of large numbers of people to align their perceptual reference standards and focus on shared goals.
> (McClelland, 1996)

## UTILIZING PCT AS AN ADMINISTRATOR

Administrators are continually concerned with determining how individuals construct meanings that control their actions and how these actions as well as discourse with others converts or molds future behavior and meaning (LeCompte, 1994). Operating under the assumption that PCT is a valid model of how control, behavior and action operate, we can proceed with a practical guide offered by Gregory Bateman. Bateman has developed a concept referred to as Double Description. Double Description is coterminous to viewing multiple realities since, as PCT ascribes, we are unable to enter the reality which exists in another human being. As an administrator, through a PCT paradigm, it is important to determine an approximation for truth/reality to the best of your ability. Double Description works together with PCT to provide and determine answers "to what I was doing; what others told me they were doing; what I thought I was doing; and, to the extent possible, what others thought I was doing" (LeCompte, 1994: 286). Through interacting and asking these fundamental questions, an administrator can gain multiple insight into the socio-historic, time, surrounding, etc. of school policy, teaching, etc. As Allen Beavis (1996:16) demonstrates, in order to accomplish this, organizations must view themselves differently:

> [S]social systems no longer merely observe themselves as distinct from their environments, they can observe themselves as observers and thus understand themselves in relation to their environments. They are able to arrive at interpretative understandings of meanings they give to their own situations and their interactions with others.

In addition to Double Description, Runkel offers what he refers to as the test. "The Test" is designed to locate internal reference signals in order to gauge which environmental influences will

operate as a disturbance to the individual's control loop (Runkel, 1990). By evaluating individual reference signals, knowledge of perception can be found which yields valuable knowledge about an individual's potential behavior in a variety of circumstances. The test consists of a variety of steps:

1) Select a variable that you think the person might be maintaining at some level,
2) Predict what would happen if the person is not maintaining the variable at a preferred level,
3) Apply various amounts and directions of disturbance directly to the variable,
4) Measure the actual effects of disturbances,
5) If the effects are what you predicted - the person is not acting to stop the disturbance - stop here. You have guessed wrong. Choose another variable,
6) If an actual effect is smaller than predicted look for what the person might be doing to stop the disturbance. You may have found the feedback function,
7) Look for the way the person can sense the variable. If you find nothing then stop. People can not control what they t don't sense,
8) If you find a means of sensing, block it so that the person cannot now sense the variable. If the disturbance continues to be opposed, you have found the right sensor. If not, stop. Choose another input quantity,
9) If all the preceding steps are passed, you have found the input quantity, the variable that the person is controlling (Runkel, 1991: 14 - 15)

Runkel is merely suggesting to analyze and acquire knowledge of the individual. Variables ,in this case, are belief structures or important issues to the individual. This test is a clinical experiment designed to determine authenticity of an individual's philosophy. Through this procedure,

identification of reference signals and feedback loops can occur. An administrator, who has built up open communication, can work together with individuals to determine their respective control loops. Together with Double Description, personal reference signals can be determined. After determining these, an administrator can analyze the staff and work together with them to align signals with the school mission statement.

Although the above "test" is theoretical, we can adapt a practical approach to identifying reference signals and feedback loops. Recall the notion that reference signals are similar to the super-ego of Freud in the sense it operates as a judgment center. External stimulus is received and the reference center analyzes this information in relative terms to the value judgment center. If this data is not in equilibrium, then an error signal is sent which is in turn results in an action or behavior. As an administrator, we can gain insight into the value center of an individual by reading a personal philosophy of education. If this document is maintained and updated it becomes a powerful reference tool. This is the perceived philosophical belief structure of the individual. With further discussions, teacher observations, peer as well as student evaluations, the differences between reality and perception can be determined. I stress the importance of open and non-threatening communication in this situation. Trust must be in place in order for these evaluation tools to maintain a positive and realistic effect.

Further analysis can be undertaken by case study investigation. Discussion of certain situations as well as reflection on past realities can yield a plethora of data to determine reference signals and feedback loops. When case study scenarios are developed, a specific community should be the basis for scenarios. Consider that urban and rural schools have different needs as well as objectives. By maintaining realistic case study situations, information will take on a life which is appropriate to the reality of teaching in your particular school. Here is an example of a possible case

study to gauge a reference signal about cooperative learning:

> John Packos has been teaching mathematics for seven years in which he has often attempted to implement new teaching ideas in his classroom. In the last three years, he has maintained cooperative learning exercises in his classroom. Each morning, students come into class and immediately move into their work groups to discuss potential problems about the homework. During this time, John takes attendance and collects homework. Students then ask him questions or he moves them in the "right" direction as he circles the classroom.

After reading this scenario, discussion occurs which leads the facilitator to gauge the reaction of the participant to the case study. This session can be video taped for the participants to watch later as well as other colleagues who can help with the evaluation. If an administrator or school was considering implementing a cooperative learning initiative they could gauge reference signals to determine how aligned the group's reference signals are as a collective body prior to discussing "how and why" further.

Yet it must be remembered that perfect alignment of reference signals can never be accomplished. Therefore, we must proceed with an attempt at maximizing the alignment of reference signals as to amplify the power of the organization. Rituals, and other cultural aspects of the school life, afford a great opportunity for an external visible foci to allow individuals to align their reference standards (McClelland, 1996). In addition, individuals can gain emotional strength from organizational activities such as rituals which yield emotion (McClelland, 1996.) Perhaps the responsibility of maintaining cultural patterns and internal integration are the most vital administrative responsibilities in terms of aligning reference signals.

When reference signals of individuals or coalition groups are not aligned, potential conflict will occur. During these times, an administrator must rely on objectives which are central to both parties and the school's objectives. Conflict can be diminished by instituting aims which are only obtainable through collective collaboration (Sherif, 1966, in McPhail & Tucker, 1990). Recall the notion of strange attractors. These meta-objectives can be utilized to align reference signals to maximize achievement of school needs and goals.

**CONCLUSION: ALIGNMENT OF CHAOS AND PCT**

Chaos theory, PCT, Double Description and the sense and respond paradigms allow an administrator to fulfill their critical administrative responsibilities: goal attainment, cultural maintenance, internal integration, external adaptation (Sergiovanni et al, 1992). If, indeed, social power arises out of the alignment of reference standards of individuals in the collective group then we can merge PCT, chaos, Double Description and the sense and respond paradigm into a working philosophy of educational administration. Returning to the idea of strange attractors we can consider the reference signals to be equated to those vision or mission statements which the collective unit has derived. Many in education envision the same mission yet semantic discourses prevent them from reaching perceived consensus. Putting semantics aside we can accommodate a plethora of teaching styles, philosophies, etc. as long as the school utilizes the sense and respond paradigm to continually evolve reflective of the external signals which influence the school environment.

Chaos theory reminds us that without continual evaluation of external changes in the environment we risk potential disaster in an organization. Through the sense and respond model, we are able to evolve while allowing the participants in the organization to experience empowerment and decision making. Yet these decisions are guided by reference points and other strange attractors which prevent self serving behavior. Integrating these methodologies can act as a potential reference

signal for administrative behavior. Through this procedure of integration, an administrator can operate as an adaptive and continually enlightened professional who can interpret external changes while remaining "true" to his/her organization.

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